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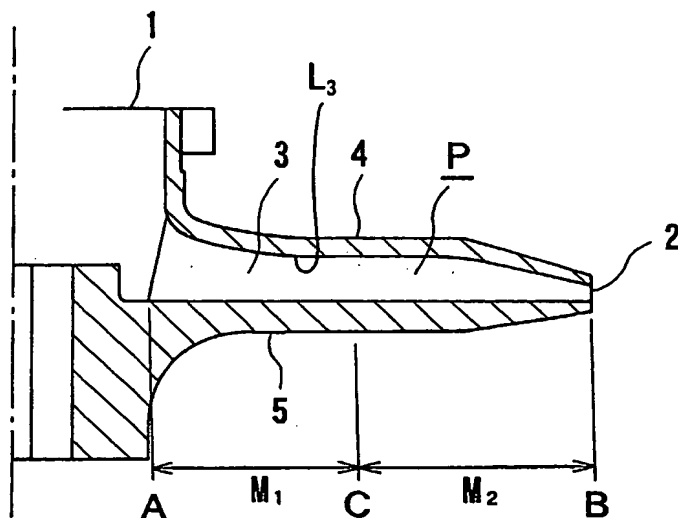
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(54) Title: CENTRIFUGAL IMPELLER AND PUMP APPARATUS



(57) Abstract: The centrifugal impeller includes a plurality of blades (3), a plurality of fluid paths (P) for delivering a fluid from an impeller inlet (1) to an impeller outlet (2), and a shroud (4) and a hub (5) for forming the fluid paths (P). Each of the fluid paths (P) is formed between adjacent two of the blades (3). A curved line (L3) of the shroud (4) curves so as to project toward the hub (5) in a region from a blade inlet (A) to a predetermined position (C) of the blade (3), and the curved line (L3) curves so as to project toward the opposite side of the hub (5) in a region from the predetermined position (C) to a blade outlet (B).

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 03/10836

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 F04D29/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 1 002 707 A (BELLISS & MORCOM LTD) 10 March 1952 (1952-03-10) the whole document	1-4, 8
X	GB 160 474 A (ADAM HILL; JAMES WAREING) 31 March 1921 (1921-03-31) page 2, line 43-57 figure 1	5-7
A	US 4 752 187 A (NICKLAS ALEXANDER ET AL) 21 June 1988 (1988-06-21) column 2, line 67 - column 3, line 14 figure 3	1, 8
A	DE 509 458 C (NAAMLOOZE VENNOOTSCHAP KONINK) 9 October 1930 (1930-10-09) the whole document	1, 5-8
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

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\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*G\* document member of the same patent family

Date of the actual completion of the international search

3 February 2004

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 03/10836

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with Indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US 3 205 828 A (RUPP WARREN E)  14 September 1965 (1965-09-14)  the whole document</p> <p>-----</p>	1,8

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/JP 03/10836

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-4,8 (part)

A centrifugal impeller comprising:

- a plurality of blades disposed between an impeller inlet and an impeller outlet;
- a plurality of fluid paths;
- a shroud and a hub for forming said fluid paths;

wherein in a meridional-plane cross section of said centrifugal impeller, a curved line of said shroud, which forms said fluid path, curves so as to project toward said hub in a region from a blade inlet to predetermined position of said blade, and said curved line curves so as to project toward the opposite side of said hub in a region from said predetermined position of said blade to a blade outlet.

2. Claims: 5-7,8 (part)

A centrifugal impeller comprising:

- a plurality of blades disposed between an impeller inlet and an impeller outlet;
- a plurality of fluid paths;
- a shroud and a hub for forming said fluid paths;

wherein a distance between adjacent two of said blades is gradually increased from a blade inlet to a predetermined position of said blade, and is decreased from said predetermined position toward a blade outlet.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 03/10836

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR 1002707	A	10-03-1952	NONE	
GB 160474	A	31-03-1921	NONE	
US 4752187	A	21-06-1988	DE 3147513 A1 FR 2517381 A1 IT 1156350 B	09-06-1983 03-06-1983 04-02-1987
DE 509458	C	09-10-1930	NONE	
US 3205828	A	14-09-1965	NONE	